

*ENVIRONMENTAL ASSESSMENT  
OF THE  
OPERATION AND MAINTENANCE  
OF*

**KNIGHTVILLE DAM**

*WESTFIELD RIVER*

**HUNTINGTON, MASSACHUSETTS**



*DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASS.*

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## PREFACE

The purpose of this Environmental Assessment is to provide the basis for evaluation of the environmental impact on the project area due to the routine operation and maintenance of this flood control reservoir. Knightville Dam has been operated whenever necessary since it was constructed to prevent or reduce downstream flooding. Maintenance and management of the project, including the recreation facilities, during non-flood periods is also of primary importance. Enhancement of the fish and wildlife resources as well as protection of the environment within and around the reservoir area has been given careful consideration.

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## I. PROJECT DESCRIPTION

### A. Location

Knightville Dam is located in the town of Huntington, Massachusetts on the main branch of the Westfield River about 27 miles above its confluence with the Connecticut River in Agawam, Massachusetts, adjacent to the city of Springfield, Massachusetts. The reservoir occupies portions of the towns of Huntington and Chesterfield (see Figure 1).

### B. Authorization

The project was authorized by the Flood Control Act of June 28, 1938 (Public Law 75-761). Construction of the dam was initiated in 1939 and completed in 1941 at a cost of \$3,220,400. The development and use of reservoirs for public recreation and other purposes was authorized by the Flood Control Act of 1944 (Public Law 78-534) as amended.

### C. Purpose

Knightville Dam provides flood protection for Huntington, Westfield, West Springfield and Agawam on the Westfield River. As a unit in the comprehensive plan of flood protection in the Connecticut River Basin, its integrated operation also reduces flood stages at damage centers along the Connecticut River below the mouth of the Westfield River.

### D. Project Dimensions

Knightville Dam is a hydraulic earth-fill embankment 1,200 feet long with a dumped rock shell and downstream rock toe. The top width of the dam is 30 feet, with slopes on both faces varying from 1 on 2.5 (one foot of vertical rise for every 2.5 feet of horizontal distance) to 1 on 3.0. The top elevation at 630 feet above mean sea level (msl) is 20 feet above spillway crest. Maximum height of the dam is 160 feet above the riverbed. The spillway is an uncontrolled, curved ogee weir 400 feet long, located on rock on the right (west) abutment of the dam, with a concrete crest at elevation 610 feet msl.

The outlet works in the west abutment consist of an intake channel 280 feet in length and a 16-foot diameter concrete lined rock cut tunnel 605 feet long. Discharges are controlled by three 6-foot by 12-foot broome gates mechanically operated through a control tower from the gatehouse above.

Under normal operations, the gates are kept open and the reservoir is empty, because no permanent pool is maintained behind the dam. During flood control operations Knightville reservoir presently has

a flood storage capacity at spillway crest of 49,000 acre-feet which is equivalent to about 5.7 inches of runoff from the drainage area of 162 square miles. When filled to spillway crest, the reservoir is about six miles long with a surface area of 960 acres and a shoreline length of more than sixteen miles. Project land owned in fee totals 2,430 acres, with 258 additional acres of flowage easements.

#### E. Regulation Procedures

The regulation of Knightville Dam is governed by precipitation reports and river stages at index stations along the Westfield and Connecticut Rivers. During normal periods, the flood gates at Knightville Dam are maintained at three-foot openings which do not retard normal river flows. To prevent ice build-up in the gate structure, flood gates are closed sufficiently to maintain a winter pool at a stage of approximately 20 feet from about December 1 to March 15. Normal river flow is not retarded significantly, once the winter pool is established.

All reservoir regulations are preceded by communications with, and instructions from the Corps' Reservoir Control Center (RCC). The Project Manager alerts RCC when any of the following conditions occur: (1) one inch of precipitation during a 24-hour period, (2) a rising stage of 522 feet msl is reached at Littleville or 25 feet at Knightville, (3) a stage of 3.8 feet is reached at the USGS gauging station on the West Branch of the Westfield River, and (4) a stage of 8.0 feet is reached at the USGS gauging station in Westfield.

Each spring the regulation of flow from Knightville Dam is modified to provide sufficient river flow immediately downstream of the dam for canoe races. This special reservoir regulation is provided at the request of the Westfield River White Water Canoe Club which conducts canoe and kayak races in the Westfield River one weekend in April. Organized seasonal canoe racing began in 1954. Procedures were established and implemented in April 1965 for regulating a flow of 1,000 to 1,400 cubic feet per second (cfs) from Knightville Dam during the races. The races are conducted in early April as natural flows may recede rapidly later and holding storage from spring runoff for later release is undesirable because of reduced flood storage capacity and possible additional damage to reservoir vegetation.

#### F. Project Management

The Knightville reservoir area is managed by the Corps of Engineers and the Massachusetts Department of Fisheries, Wildlife and Recreational Vehicles. The Corps operates the Indian Hollow Campground, 4 miles upstream of the dam, and a small picnic area located near the



# KNIGHTVILLE DAM HUNTINGTON, MASSACHUSETTS

## SITE LOCATION MAP

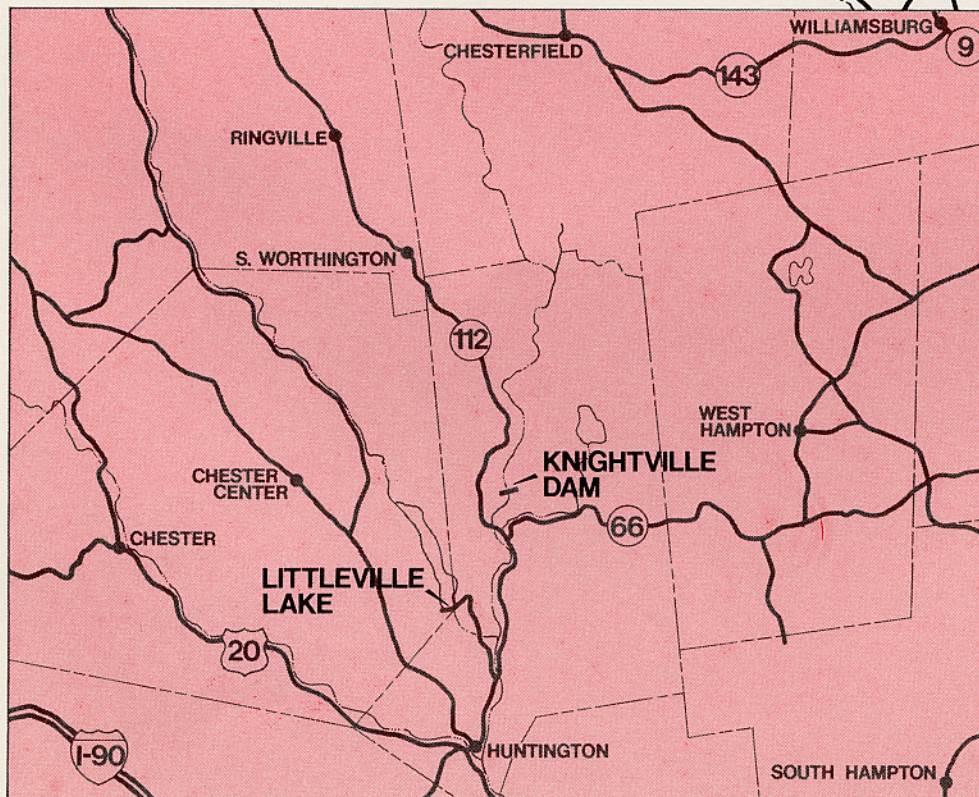
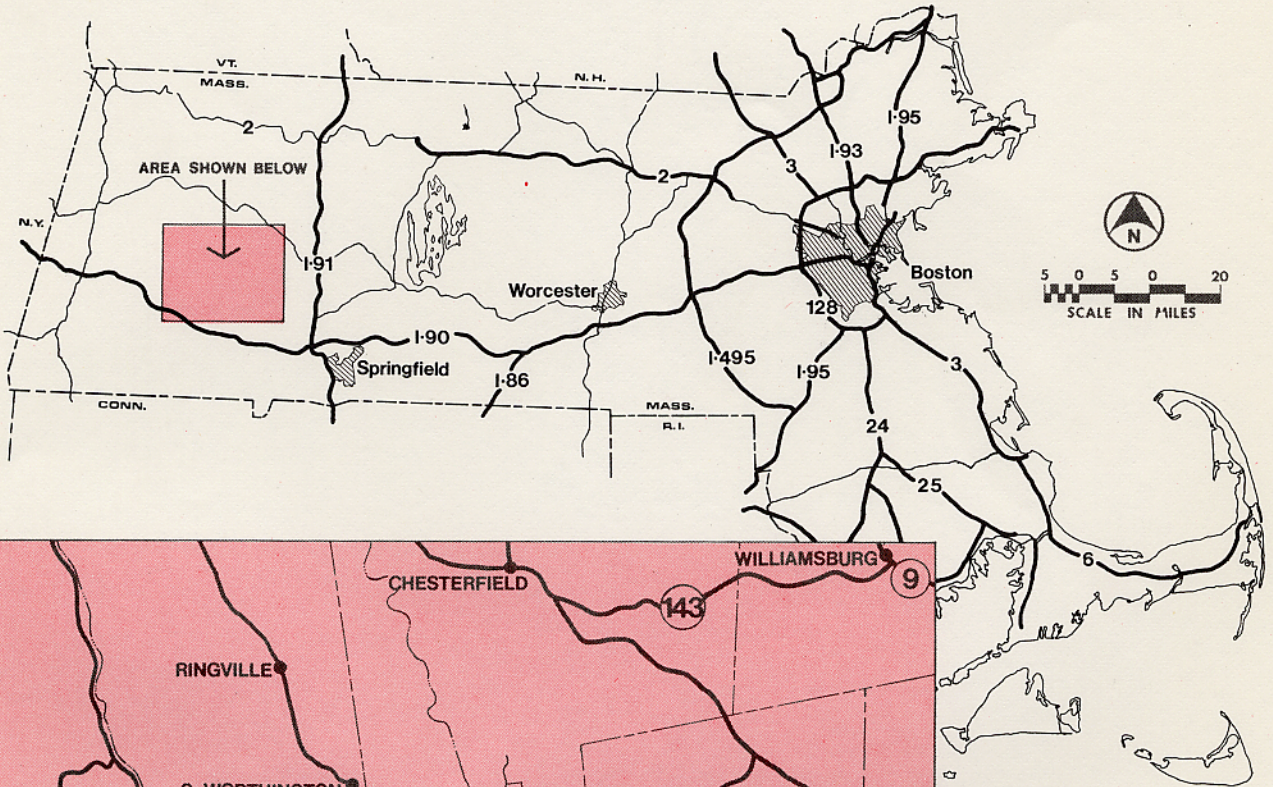
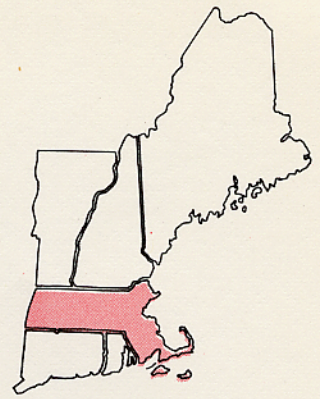


Figure 1



dam. The Massachusetts Department of Fisheries, Wildlife and Recreational Vehicles holds a license to conduct an annual pheasant stocking program in 2,100 acres of the reservoir and stocks trout in the streams within the reservoir area.

The Corps of Engineers retains authority and responsibility for all management activities in the licensed area that do not pertain to fish and wildlife management. These activities include, but are not limited to, the maintenance of roads, timber management, trails management, and administration and control of recreation activities other than fishing, hunting and trapping.

## II. ENVIRONMENTAL SETTING

### A. Area Description

The region surrounding Knightville Dam and Reservoir, including the Massachusetts towns of Huntington and Chesterfield, in Hampshire County, is predominantly rural in character. The nearest urban centers are the communities of Westfield, 16 miles downstream of Knightville Dam, and Springfield and West Springfield, Massachusetts, on the Connecticut River, 25 miles southeast of Knightville Dam.

The region is generally referred to as the Berkshires, an area of rugged topography between the Connecticut River Valley and the Berkshire Valley (which includes both the Hoosic and Housatonic River Valleys). The combination of rugged topography, low population density, lush forest vegetation, and scenic rural New England charm make this region a major center for recreation and tourism in the northeast.

The Westfield River Basin extends from the eastern slopes of the Hoosic Range east of Adams, Massachusetts downstream to the confluence with the Connecticut River in Agawam, Massachusetts. The river basin encompasses 517 square miles. Of this total the runoff from 162 square miles is controlled by Knightville Dam on the main branch of the Westfield River. An additional 52.3 square miles of the basin is controlled by Littleville Lake on the Middle Branch of the Westfield River, approximately two linear miles southwest of Knightville Dam.

### B. Topography

Elevations in the Westfield River watershed vary from 2,505 feet msl in the headwaters to about 40 feet msl at the river's confluence with the Connecticut River. The 517 square mile watershed has an approximate length, north to south, of 48 miles and an average width

of 11 miles. The Westfield River has a gradient of 34 feet per mile from its source to Knightville Dam, but it drops an average of only 7 feet per mile from the Westfield city line to its mouth. In the immediate vicinity of the project, elevations range from about 470 feet msl to more than 1,400 feet atop some of the surrounding hills.

### C. Vegetation

The Knightville project area lies within the northern hardwood forest zone, typified by American beech, yellow birch, and sugar maple as the predominant species in mature woodlands. Commonly associated species are eastern white pine, eastern hemlock, black cherry, white ash, American elm, oaks and hickories. The more open sites and abandoned agricultural fields are characterized by pioneer species such as aspen, gray and paper birch, and other relatively short-lived trees. Existing woodlands are not virgin stands but instead are second growth forests that have reclaimed land that was once largely cleared for farming and timber harvesting. Vegetation management is limited to work done in conjunction with a pheasant management program. The Massachusetts Division of Fisheries and Wildlife has planted cover and grain crops and shrubs in the flat area along the Westfield River and the lowermost portion of the Little River. Plantings have included buckwheat, winter rye, hay, and multi-flora rose.

A review of the proposed list of Endangered and Threatened Species (Plants) as published in the Federal Register, June 16, 1976 (Vol. 41, No. 117, pp. 24524-25472) and records of the Harvard University Herbarium indicate that no endangered or threatened plant species are known to exist in the project area.

### D. Geological Features

The Westfield River drainage basin is known geologically as the Green Mountain Highlands which form a belt extending southward from Vermont across Massachusetts. The western half of this highland is formed largely from ancient gneisses and granites and the eastern portion from later schists, with extensive accumulations of glacial till. At higher elevations in the western part of the basin Hermon soils and rough stone land predominate. Rough stone soils have little agricultural value and the land, much of which was once cleared for farming, is now predominantly woodland with occasional pastures. In the eastern part of the basin, a large proportion of the soils are of the Gloucester series, a sandy loam derived from coarse textured glacial till. A notable geologic feature in the region is the Chesterfield Gorge, a rock chasm located 6.5 miles upstream of the dam in an area owned by the Massachusetts Trustees of Reservations.

## E. Fish and Wildlife

The Westfield River drainage basin contains both cold and warm water fish. Smaller tributary streams and the main branches in the upper watershed provide the most suitable trout habitat, while the lower basin supports mainly warm water species.

Within the reservoir area, species include brook, brown and rainbow trout, white sucker, creek chub, black-nosed dace and other minnows. Trout populations are sustained largely through stocking, although there is some carry-over and natural reproduction. Typical warm water species inhabiting the Westfield River below Knightville Dam are brown bullhead, yellow perch, bluegill, smallmouth and largemouth bass, and chain pickerel.

The rural, mostly forested area surrounding Knightville reservoir offers a diversity of both game and non-game wildlife. The only big-game animals at the project are white-tailed deer and occasional black bear. Upland game species found in the reservoir area are red and gray squirrels, ruffed grouse, woodcock, cottontail rabbit, and varying hare. Waterfowl utilization of the project is relatively low, but small nesting populations of wood ducks and hooded mergansers have been observed in the past. During migration, black ducks, blue-winged teals, green-winged teals, and American mergansers use the Westfield River for feeding and resting.

Red and gray foxes, bobcats, weasels, opossum and striped skunks inhabit the reservoir or include it in their range. Other mammals generally associated with the stream environment are raccoon, mink, otter, beaver and muskrat.

The osprey and marsh hawk, both of which are considered to be locally rare, have been sighted in the Knightville project area. A review of the list of Endangered and Threatened Wildlife as published in the Federal Register, October 27, 1976, (Vol. 41, No. 208, pp. 47108-47198) indicates that there are no known wildlife species in the project area considered to be endangered or threatened.

## F. Existing Water Quality and Water Supplies

The Westfield River, including the reach above Knightville Dam, has been classified by the Massachusetts Division of Water Pollution Control as Class B water. These waters are suitable for bathing and other water contact recreation. Class B waters are acceptable for public water supply after appropriate treatment. It is also suitable for agricultural uses and certain industrial cooling and process water. Class B waters provide an excellent fish and wildlife habitat in addition to being of excellent aesthetic value.

The Corps of Engineers has been collecting periodic seasonal water samples at inflow and outflow stations of the dry bed reservoir since 1970.

Five parameters are routinely obtained: temperature, dissolved oxygen, pH, conductivity and turbidity. Other parameters which have been sporadically or solitarily measured are total coliform bacteria, fecal coliform bacteria, color, hardness, ammonia, nitrite, nitrate, phosphate, calcium, chloride, fluoride, chlorine and some heavy metals.

These parameter measurements indicate that the standards for Class B waters are not always achieved in the river normally flowing through the project. Some of the total coliform bacteria samples taken in four years of sampling exceed the concentration limits of the Class B standards. The maximum single total coliform bacteria count was 6,500 bacteria per 100 ml in July 1973. The pH standard was not always achieved at either the inflow stations or the discharge station. The range of pH values has varied from 5.3 to 8.2. Although no dissolved oxygen concentrations were measured less than the minimum 5 mg/l allowable for Class B waters, approximately 17 percent of the dissolved oxygen measurements were below the 75 percent saturation level. The duration of dissolved oxygen saturation level below 75 percent was not determined. Water temperature (°F) at the inflow station was often recorded in the high 70's during the summer months between 1970-1973, inclusive. In July 1971, a water temperature in the low 80's was recorded.

Water supplies are provided by wells located at the Indian Hollow campground, and the Project Manager's office at the dam. These two wells provide adequate supplies of water for sanitary facilities, drinking supplies, and operation and maintenance requirements.

#### G. Archaeological and Historic Resources

A cultural resource management program is currently being developed to evaluate all of the Corps of Engineers operated and maintained dams and lakes within the jurisdiction of the New England Division. This program will be conducted in compliance with the National Environmental Policy Act, the National Historic Preservation Act, Executive Order 11593: Protection and Enhancement of the Cultural Environment, as well as other related Federal Regulations and Guidelines.

During the summer of 1976, the New England Division Archaeologist conducted and completed a reconnaissance of the site of the new restroom facility at Indian Hollow campground and in the immediate vicinity of the dam. The reconnaissance included a literature search,

a field reconnaissance and selected subsurface testing of the ground surface in each area. No cultural resources were identified within either survey area.

Beginning in October 1978, the Corps will conduct a cultural resource reconnaissance of several projects each year depending on the availability of funds. Each study will include an intensive literature search and field reconnaissance of all lands within the Corps' jurisdiction and control. Knightville Dam will be scheduled for inventory when funds become available. Should development of additional recreation facilities take place during the interim, the areas of direct impact will be reconnoissanced and evaluated prior to development of the facilities.

#### H. Climate and Precipitation

The climate of the Westfield River basin is characterized as humid continental, due to the prevailing westerly winds which deliver interior continental weather to Massachusetts. Local conditions can vary throughout the region due primarily to the large differences in local topography. While the lower basin is relatively mild, the rougher topography and higher elevations at the headwaters of the tributaries experience a more severe climate.

The mean annual temperature in the basin ranges from about 44°F in the mountainous regions to about 50°F in the lower valleys. Extremes of 102°F and -30°F have been recorded in the basin. The average January temperature at the project is 23°F, while the average July temperature is about 70°F.

Storms over the watershed are of four general types: (1) extra-tropical continental storms which move across the basin under the influence of the prevailing westerly winds, (2) extratropical maritime storms which originate over the ocean and move northward along the eastern coast of the United States, (3) storms of tropical origin, sometimes of hurricane magnitude and intensity, and (4) thunderstorms produced by local convective action or by more general frontal movements. Historically, tropical storms have been the most severe and have occurred during late summer and early autumn.

Precipitation is evenly distributed among the seasons and averages about 46 inches at nearby Chester, Massachusetts. Snowfall varies widely over the basin, with an average depth of about 55 inches at the dam (elevation 630 feet msl) and over 70 inches at Chesterfield (1,425 feet msl) and Peru (1,860 feet msl). Annual runoff for the Westfield River near Westfield, Massachusetts has varied from 45.30 to 14.82 inches with a long term mean of 26.12 inches.



Minor floods are frequent in the basin usually because of intense rainfall, melting snow, or a combination of both. Floods develop very rapidly in the basin, and experience gained from regulation of Knightville Dam and Littleville Lake indicates that floods in the principal branches of the Westfield River crest about four hours after the end of intense rainfall. At Westfield, the time of concentration is between six and eight hours following the end of heavy precipitation.

### I. Regional Land Use

The land use study area or that area considered directly affected by Knightville Dam and Reservoir includes the towns of Chesterfield, Huntington, Montgomery, Russell, Agawam, West Springfield, and the city of Westfield. Chesterfield and Huntington are located in Hampshire County; the other five communities are in Hampden County.

The study area, which totals 112,260 acres, can be divided into an urban sector and a rural sector. The urban sector consists of the communities of West Springfield, Agawam, and Westfield. The towns of Chesterfield, Huntington, Russell and Montgomery make up the rural sector. Over one half of the total land area is uninhabited. Much of this land is heavily wooded with rugged hillsides.

Recreational use makes up the largest proportion of total land area developed. Land uses are summarized in Table 2-1.

TABLE 2-1  
REGIONAL LAND USE

	Total (in acres) for study area	% of total land developed
Residential	8,185	17.1
Commercial	531	1.1
Industrial	1,061	2.2
Transportation	4,520	9.5
Recreation	18,244	38.3
Public Utilities	725	1.5
Public Buildings	358	.8
Agriculture	<u>14,067</u>	<u>29.5</u>
Total Land Developed	47,691	100.0

The land immediately surrounding the Corps property is undeveloped. A wildlife area maintained by the State borders the reservoir on the north. Not too far from the area, still in Huntington, is the Gardner State Park which provides facilities for picnicking, swimming, fishing, hiking, ski touring, and horseback riding.

TABLE 2-2

## REGIONAL LAND USE

Land Use Figures in Acres	Residential	Commercial	Industrial	Transportation	Recreation	Public Utilities	Public Buildings	Agriculture	Total Land Developed	Vacant Land	Water Bodies	Total Area Land & Water	Total Land Area
Chesterfield	330	7	14	-	1769	15	6	665	2806	16,938	102	19,846	19,744
Huntington	490	16	44	173	3406	69	11	1349	5558	10,360	1219	17,137	15,918
Montgomery	203	-	-	121	2730	31	5	881	3971	5602	111	9684	9573
Russell	201	10	42	194	3204	65	5	100	3821	7467	269	11,557	11,288
Westfield	2741	208	579	2265	2596	229	157	5190	13,965	15,901	538	30,404	29,866
Agawam	2149	95	105	790	2245	185	40	5200	10,809	4324	453	15,586	15,133
No. Springfield	2071	195	277	977	2294	131	134	682	6761	3977	493	11,231	10,738
Total For Study Area	8185	531	1061	4520	18,244	725	358	14,067	47,691	64,569	3185	115,445	112,260

Source: Lower Pioneer Valley Regional Planning Commission

Agricultural use, second to recreational use, makes up 29.5% of the total land developed. Agricultural land comprises the largest percentage of developed land in Agawam with 48.11% and in Westfield with 37.16%. In the rural communities, agricultural and recreational land uses total over 85% of the developed land area in each community.

Any significant concentration of manufacturing activity lies in Westfield and West Springfield. Commercial and industrial development tend to locate in the flood plains between the Westfield and Little Rivers where they are seriously threatened by flooding. As a suburb of Springfield, West Springfield has the largest percentage of 30.64% of residential development of the seven communities in the study area. Table 2-2 indicates the land use for the study area in major use categories.

#### J. Population

The entire region has experienced increases in population from 1960-1970 with the largest increase in Montgomery with a 39.3% population growth. Projected growth is shown in Table 2-3 with data compiled by the Lower Pioneer Valley Regional Planning Commission.

TABLE 2-3  
LPVRPC POPULATION FOR 1970 AND PROJECTION FOR 1990

	1970 Pop.	% Change 1960-70	1990 Pop.	% Change 1970-90	Density 1970
Chesterfield	704	26.6	900	27.8	23
Huntington	1,593	14.4	1,700	6.7	61
Montgomery	466	39.9	600	28.7	31
Russell	1,382	5.8	1,500	8.5	78
Westfield	31,433	19.5	39,500	25.6	671
Agawam	21,717	37.8	33,200	52.8	930
West Springfield	28,461	14.1	36,200	27.1	1,699

The urban area has an average population density of 937 persons per square mile; the rural area an average of 47 persons. This greatly contrasts with the density of 14,846 persons per square mile for the city of Boston.

#### K. Economics

Manufacturing plays a major role in the economy of the Westfield River Basin, with most of the diverse activity concentrated in the urban communities of Westfield and West Springfield. These lowland areas were developed first because of their close proximity to river transportation. In Westfield, the manufacture of whips and the making of cigars became principal occupations early in the 19th century.

With the growth of firms producing such things as bicycles, textile machinery, wood products and precision tools, Westfield rapidly changed from an agricultural community to a thriving industrial city by the latter part of the 19th century. Industrial growth was also pre-dominant in West Springfield during the first part of the 19th century. There were tanneries, a gin and brandy distillery, and a hat factory. Later came a cotton factory, 2 paper companies and a steam sawmill and grist mill.

Throughout the region, manufacturing traditionally has been the most important sector of the economy, accounting for roughly half of total employment. In the first half of the 20th century, employment in manufacturing declined, a trend apparent not only in this region and the Commonwealth of Massachusetts; but also, in New England and the country as a whole. During this period, the region followed the National and State trends with increased shares of employment in the wholesale, retail and service sectors. Over the past few decades, manufacturing has not declined at the same rate, but has shown a shift from non-durable industries to durable industries.

In the urban area of Westfield, West Springfield and Agawam manufacturing was first or second to wholesale and retail trade as the largest source of employment as indicated in Table 2-4.

TABLE 2-4  
EMPLOYMENT DISTRIBUTION

Source: Town	Percentage of Employment in Manufacturing	Percentage of Employment in Wholesale & Retail Trade
Westfield	54.7%	27.0%
West Springfield	26.5%	38.5%
Agawam	43.2%	24.4%

Early industry in the rural area of Chesterfield, Huntington, Montgomery and Russell included grist mills, saw mills, cider mills and paper mills. The rugged and mountainous terrain that covers much of this area inhibited any further industrial development. Agriculture then became economically important with maple products such as syrup, sugar and candy among the principal goods.

Income data was not available for all the communities in the study area, so county data has been compared. The median income of Hampshire County including Chesterfield and Huntington was \$5,197; of Hampton County including the other 5 communities it was \$8,431, with an average for the urban area of \$10,567.\*

\*U. S. Census, 1970

### III. ENVIRONMENTAL IMPACT OF THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM

#### A. Project Operation

##### 1. Downstream Flood Prevention

Since its completion in 1941, the operation of Knightville Dam for flood control has prevented damages in excess of \$17.5 million. The reservoir has been filled 37 times to a stage of 60 feet (540 feet msl) or greater, representing 13 percent of the total flood storage capacity. The most significant flood control operations occurred in January 1949 (when the total storage capacity was utilized and a small amount of spillway discharge occurred), October 1955 (96 percent of flood control storage), April 1960 (60 percent), and August 1955 (58 percent).

Primary flood damage reduction benefits accrue to the city of Westfield, where several thousand acres of developed flood plain are subject to flooding. The project also contributes to reducing flood stages on the main stem of the Connecticut River from the damage centers of Springfield and Agawam, Massachusetts to Hartford, Connecticut. Operation of the project would prevent damages of \$10.5 million in a recurrence of the March 1938 Connecticut River Basin flood of record and \$3.5 million in a recurrence of the August 1955 flood, the flood of record in most of the Westfield River watershed. These potential damages are somewhat higher than previous estimates, due in part to recent construction in the flood plain.

##### 2. Vegetation

Regulation of flood flows on the Westfield River and the Middle Branch has little effect on riparian vegetation, except in the flood plain areas from immediately above the city of Westfield to the Connecticut River. In this reach, the river valley is wide and contains numerous farms, industries, and commercial and residential buildings which are subject to flooding. Shade-grown tobacco is an important crop in the Westfield area and about 20 farms situated on flood plain lowlands, particularly near the mouth of the Little River, have experienced heavy flooding and siltation. The two upstream reservoirs and local protection works aid in reducing crop damages and losses.

In regulating Westfield River floods to mitigate damages in the city, inundation of some undeveloped bottom land located adjacent to the river between the Westfield city line and the intensively developed flood plain is also reduced. This area, which supports brush cover and bottom land hardwoods, depends on and benefits from periodic flooding to maintain those plant and animal communities which have adapted to the semi-wetland conditions.

Much of the reservoir is forest covered, and a distinct transition from basically open land to pioneer tree growth, to mixed forest can be seen on the hillsides flanking the reservoir basin. Regular flooding has killed almost all the woody vegetation on the lowest 300 to 400 acres of the reservoir, although a large portion of the area near the river had been cleared for agriculture prior to construction of the project. Frequent flood control operations, plus maintenance of a pool during World War II to augment flows for hydroelectric power production at downstream plants, have resulted in the loss of most trees below approximately the 500-foot contour, but some regrowth of aspens, birches, red maples and other trees has occurred along the forest edges on the reservoir slopes.

Few perennial plants have been able to survive flooding in the bottom of the reservoir. Annual weeds, grasses and other herbaceous plants thus comprise the basic vegetative cover in those areas which are left dry from the end of the spring flood period through the growing season. Vegetation at higher elevations in the reservoir shows progressively less mortality or damage from flooding, and the mature forests on the hillsides appear generally healthy.

### 3. Fish and Wildlife Habitat Effects

Nineteen significant storage operations (stage exceeding 60 feet, 13 percent of capacity) have occurred during the prime cold water fishing months of April, May and June since Knightville Dam was constructed. The average volume of water stored in these instances has been about 13,300 acre-feet, inundating 4 miles of the Westfield River or 60 percent of the total length subject to flooding, plus 0.6 mile of the Little River. Loss of stream fishing opportunity has been attributable directly to inaccessibility or undesirable conditions caused by high water, to muddy banks, silt and debris accumulation after pool drawdown and, on occasion, to the inability to stock at the normal times before and during the spring trout season. In spite of regular flooding of portions within the reservoir, the Westfield River is a heavily used and important trout stream for much of its length.

More than 470 acres of reservoir land have been flooded on an average of once every ten months. Flood storage operations have taken place throughout the year, but impoundment in April for spring runoff has accounted for 40 percent of the significant operations. The 470-acre area subjected to annual or more frequent flooding includes all of the land in the vicinity of the Little and Westfield River confluence which is managed as a stocked pheasant hunting area by the Massachusetts Division of Fisheries and Game. The Division had in the past planted various herbaceous cover and food plants for enhancement of pheasant habitat, but these programs have been discontinued, partially due to the failure to realize significant

benefits in view of recurrent flooding. The area has little value for other forms of wildlife since vegetation is scant, but does serve as part of their range when not under water.

As a normally empty reservoir during non-flood periods, Knightville Dam does not retard flows in the Westfield River and, therefore, has no detrimental effects on downstream biota. The river has a relatively steep gradient of about 25 feet per mile for more than 10 miles below Knightville dam which produces water velocities sufficient to prevent most fine suspended matter from settling out except when flows are very low.

During a moderate or major flood, reservoir discharges are restricted to a minimum flow (about 10 cfs) which is considered necessary for maintenance of downstream fish life. Impoundment during large floods may require this minimum flow for two to four days as high inflows to the reservoir need to be stored temporarily. For example, in January 1949, when the pool reached spillway crest elevation, minimum flow occurred for just under three days, and in August 1955 for less than four days. Sykes Brook joins the Westfield River about one-quarter of a mile downstream from Knightville Dam, and Pond Brook plus two small unnamed streams also enter the river between the dam and the confluence with the Middle Branch. Discharges from these streams augment the minimum releases and prevent sustained low flow conditions from occurring in the Westfield River immediately downstream from Knightville while water is being impounded. For many flood regulations, flows of up to 400 cfs have been permitted downstream while the reservoir stage was rising.

Heavy rainfall and runoff in the watershed usually produce turbidity in the Westfield River. When flood control operations become necessary, and waters are impounded, any sediment which has settled to the bottom of the reservoir near the gate structure is released as the flood pool is drawn down. Problems with inordinately high suspended solids concentrations in the discharge or with sedimentation in the downstream channel have not been significant. Both problems are minimized by the high stream gradient, and the magnitude of peak regulated discharges accompanying drawdown, which have historically averaged about 3,200 cfs with a maximum of 6,600 cfs in March 1945. It is probable too that sediment loads are decreased somewhat, since some of the fine material is deposited in the upper reservoir and is not discharged immediately.

#### 4. Water Quality

Flood conditions resulting in rapid runoff and soil erosion increase the sediment load to the Westfield River. By reducing the

peak flow, flood control operations have altered the riverine sediment transport system by prolonging turbid conditions and decreasing the maximum instantaneous settleable solids concentration downstream of the project. However, it is improbable that significant changes in the chemical quality of flood waters occur during the short detention time in the reservoir.

Non-flood operation of Knightville Dam has little or no impact on water quality because no water is stored behind the dam and river flow is not impeded.

## 5. Aesthetics

The two important aesthetic concerns at Knightville Dam, as at most flood control reservoirs, are the visual impacts of the dam and its associated structures, and the fluctuating flood pool effect on the reservoir landscape.

The rock covered dam and concrete spillway form a barrier 160 feet above the river and 1,600 feet across the river valley. The earth fill dam covers approximately 15 acres, imposing a large unnatural form on the rural landscape of the Westfield River valley. The spillway discharge channel encompasses approximately 9 acres that have been cleared of trees leaving a conspicuous opening in the river bank vegetation, highly visible from the road to the picnic area below the dam.

The principle aesthetic concerns associated with the fluctuating flood pool periodically created behind Knightville Dam involve debris accumulation, siltation and damage to natural vegetation by inundation or ice movement.

Debris may enter the pool with runoff from upstream watercourses or when the rising flood waters inundate reservoir upland. Most debris eventually floats downstream to be trapped by a stop log barrier near the upstream base of the dam. Accumulated debris is then removed by the Project Manager.

Damage to vegetation by flood pool inundation varies according to the season, duration and depth of inundation, height of plants, extent of siltation and the particular susceptibility of each species. Ice movement can also cause additional damage by injuring bark and stripping branches. Ice damage is most noticeable below an elevation of approximately 540 feet msl where many branches have been stripped from large trees, and shrubs and small trees have been damaged.

The siltation which can occur in the reservoir basin after a major flood control operation and the vegetation damage inflicted



directly by inundation can temporarily diminish the aesthetic appeal of the area for general recreation use. Summer impoundments, such as in June-July 1973, are the most destructive as they occur during the growing season and have often destroyed all the foliage of both coniferous and deciduous species. The needles of pines and hemlocks are normally persistent for two or more seasons, and thus these trees are somewhat more susceptible than hardwoods to flood damage induced loss of foliage. Many of the hardwoods, however, are able to survive the loss of one year's foliage and have been observed to bud and leaf out fully in the next growing season.

Major damage susceptibility is now minimized by the age of the project in that the frequent inundations since 1941 have by now eliminated sensitive species leaving the more tolerant species to dominate the upper elevations of the reservoir. The lowest areas were either already cleared for agricultural uses prior to construction of the dam or were cleared for a pool which was maintained during World War II. The lower elevations of the reservoir area are now dominated by water tolerant grasses, herbaceous growth and some woody shrubs after the pool is drawn down in the spring.

## B. Construction and Maintenance of Project Facilities

### 1. Spillway Modification

Engineering studies of the existing structures of Knightville Dam indicate that modification of the spillway should be accomplished to bring the structure up to present day structural and hydrologic design criteria. Modifications recommended consist of additional structural stabilization of the spillway by means of drilled in place, post-tensioned rock anchors. These anchors will consist of steel cables drilled through the concrete spillway into the bedrock beneath.

Construction activity associated with spillway modification will be limited to the existing structure and the bedrock beneath with minimal impact to the area.

### 2. Recreation Facilities

There is presently a group camping area at the Indian Hollow Campground, with adequate room for possible expansion in the future. The single vehicular access is via Huntington Road which leads into the reservoir from South Street in Chesterfield. Recent improvements to the area include construction of a restroom building with flush toilets and showers and elimination of an unnecessary road to provide better vehicle circulation and more recreation open space. Inundation of the camping area occurs only at high pool stages and therefore its use is not normally curtailed except in the event of rare major summer impoundments.

Immediately downstream of the dam is a small picnic and day use area adjoining the river. The river here is utilized for fishing and white water canoeing. Sanitary facilities are planned for this area in 1979.

### 3. Sewage and Solid Waste Disposal

There are no major problems with waste disposal at the Knightville project. Construction of improved sanitary facilities at Indian Hollow Campground has recently been completed and are planned to be completed in the near future for the picnic area below the dam. Littering and improper trash disposal are evident in several parts of the reservoir, and the Division of Fisheries and Wildlife has noted particular problems during the fall hunting season. However, the Corps has little control over undeveloped areas which are used by fishermen, hunters, hikers and other recreationists. By locating camping and picnicking facilities in relatively small areas, most solid waste can be removed by routinely emptying the trash receptacles, and much of the littering which does occur is confined to a similarly small area, facilitating general clean-up during and after the recreation season.

## C. Management of Project Lands

### 1. Rules and Regulations

The main objective of rules and regulations at reservoir lands managed by the Corps is to provide for the health and safety of the visiting public. Negative signs and warnings have been held to a minimum so that the public may enjoy the greatest freedom without unnecessary restraint. Access roads leading into the reservoir are barricaded while water is being stored. The Division of Fisheries and Wildlife has established "Rules and Regulations for Public Shooting Grounds in Massachusetts" which apply to all wildlife management areas. This list of ten rules, posted conspicuously at several locations in the public hunting area, generally prohibits activities which would damage vegetation or Government property or which would threaten the safety of other hunters and recreational users of the project. Massachusetts fish and game laws also apply to fishing, hunting and trapping at the project. The above rules and regulations are reasonable and, if obeyed, help to protect natural environmental and aesthetic values in the reservoir.

### 2. Fish and Wildlife Management

The Westfield and Little Rivers are heavily stocked and heavily fished in and above the reservoir area. Much of the land along the Westfield River upstream from Knightville Dam through Chesterfield

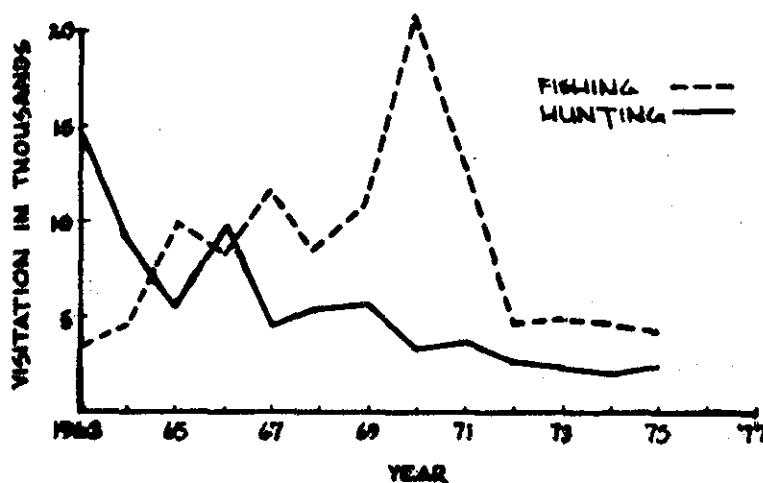
is in public ownership or is leased to provide public access for stream fishing and other recreational activities.

The Division of Fisheries and Wildlife has noted a general scarcity of suitable trout cover, for example, undercut and overhanging streambanks and deep pools, in the upper reservoir and other reaches of the Westfield River, and has considered stream improvement work as a means of creating additional cover. Pools of several feet in depth would be especially valuable in providing cooler water temperatures for holding trout through the warm summer months. Whereas most of the river is very shallow during low-flow periods, such pools would also retain greater depths for sustaining trout populations.

The Division of Fisheries and Wildlife's wildlife management program at the Knightville project now consists only of pheasant stocking and periodic brush cutting on the reservoir bottom land to maintain open habitat. The program has little effect on the reservoir environment or other wildlife, but nevertheless helps to meet part of the high demand for hunting opportunities. Publicly owned land has become more important in this respect as posting of private land has increased. Also, hunters from the more urban areas often prefer to hunt on public land instead of searching for unposted areas or contacting landowners for permission to enter their property.

### 3. Recreational Use and Management

Total visitation at Knightville Dam and the reservoir area averaged about 71,000 per year in the period 1963 through 1975. A large portion of this visitation is composed of sightseers, many of whom did not actually use the project lands for various recreational activities, but only visited the dam site itself. However, fairly accurate estimates of hunting and fishing use have been made by project personnel based on car counts and observation. These are shown on the following graph.



As can be seen from the figure, hunting at the project has shown a general decline in the past decade. Reasons for this pattern are not readily apparent; however, pheasant stocking in the same period was maintained at about 1,000 birds annually and thus cannot be pinpointed as a contributing factor. Low hunter utilization in the 1973 season may have been due to the summer flood control operation which inundated 380 acres in the reservoir. The downward trend in hunting use could be a response to overcrowding, since, for example, a season total of 5,000 small game hunters would represent an average day's visitation of about 125 and probably 400 or more on peak days. The Division of Fisheries and Wildlife should perhaps reassess its management program at Knightville in light of reduced hunting pressure, which may be an indication that hunters prefer to use other public areas or private lands because of the crowded and rather poor cover conditions in the lower reservoir or that some are foregoing the opportunity altogether. Further decreases or a leveling off of hunting pressure would perhaps justify a partial cutback in the number of pheasants stocked.

#### 4. Forestry Management

A forest management plan for Knightville reservoir is presently being prepared by the Corps. Objectives are basically to inventory the forest resources and develop a program to enhance the value of the forested lands in the reservoir for public recreation, wildlife habitat, aesthetic purposes, and for the preservation of natural conditions. The forested areas at the project are for the most part well stocked with a diversity of age classes and species. Commercial timber production is not a specific management objective; environmental benefits of the woodlands would exceed the value realized from harvesting limited amounts of merchantable timber.

In implementing the plan, growth, reproduction, disease, insect damage and other factors affecting the resource can be closely observed and protective measures taken where needed to insure the continued viability and conservation of the forest land at the project.

#### IV. PROBABLE ADVERSE ENVIRONMENTAL EFFECTS OF THE OPERATION AND MAINTENANCE WHICH CANNOT BE AVOIDED

##### A. Fish and Wildlife Losses

Dispersion of resident fish species by reservoir inundation almost every year may have short-term adverse affects. When significant reservoir filling occurs during early or mid-summer, the

upstream river fisheries are most susceptible to losses as spawning or early development of fry is interrupted. Any such damage should not be serious except in the event of an unusually large storm when the reservoir would be filled for an extended time, particularly during the breeding season.

Reservoir regulation may result in frequent losses to small game and non-game animals which are more susceptible to drowning during flood operations. There is no present indication, however, of any significant decrease in local animal populations.

#### B. Periodic Inundation of Vegetation

Storage of flood waters behind Knightville Dam has resulted in a detrimental impact on vegetation in the reservoir area. The major impact on trees and other vegetation caused by frequent inundation occurs in the lower reservoir, although the greatest loss occurred within the first few years of operation. Most vegetation now growing in the lower reservoir area is comprised of species which tolerate inundation with little apparent damage. In the higher elevations of the reservoir area, because flooding is much less frequent and of short duration, vegetation losses have been minimal.

#### C. Downstream Water Quality

Present operation of Knightville Dam has little or no impact on water quality in non-flood periods, as outflows are equivalent to inflows. However, rapid runoff associated with flood periods generally causes increased erosion and, consequently, increased sediment loads in the waters of the Westfield River and its tributaries upstream of Knightville Dam. Historically, flood waters have been stored in Knightville reservoir for a maximum of just over two weeks, but residence times are often considerably less depending on a number of hydrologic factors and hydraulic operating criteria. By delaying and reducing peak flows, flood control operations have typically had the effect of prolonging turbid conditions in the river. If unimpeded by the dam, sediment would be carried downstream as far and as long as flow and velocity were sufficient to keep the material in suspension. Although some settling out does occur in the reservoir, storage times are not adequate to allow significant clarification of the stored water. Moreover, the discharge structure unavoidably releases the most turbid water from the bottom of the pool. It is improbable that important changes in the chemical quality of flood water occur during the short detention time in the reservoir; nevertheless, the accumulation of organic and inorganic oxygen-demanding detritus might temporarily suppress dissolved oxygen levels while the pool is being drawn down after the recession of a flood.

## V. ALTERNATIVES TO THE OPERATION, MAINTENANCE AND MANAGEMENT PROGRAM

### A. Discontinuance of Authorized Flood Control Operation

Knightville Dam is an essential part of the Westfield River flood control system. Even with the Knightville and Littleville projects in full operation, there exists a need for further flood plain protection in the city of Westfield because of continuing development. Local protection measures for the city of Westfield are currently under study. In addition, the Soil Conservation Service is presently planning a series of nine flood control and multi-purpose reservoirs on the West Branch of the Westfield River. The projects would have a combined capacity for retarding flood waters of 9,631 acre-feet, equivalent to 5.4 inches of runoff from the upstream drainage areas of 33.4 square miles. However, major flood protection benefits would accrue to the towns of Chester and Huntington, with relatively little effect on flood stages at Westfield.

### B. Land Management Alternatives

The Corps of Engineers' policy in managing its reservoirs is to allow for optimum public use consistent with flood control objectives. However, the various types of management programs suitable for a given project depend in part on such factors as: geographic location; topography; frequency, duration and extent of reservoir flooding; supply of and demand for various forms of land and water oriented recreation; and compatibility of different land and water uses with one another. These physical constraints determine the suitability of an area for one use along or for many coexisting uses which can be managed simultaneously.

Multiple purpose resource management has come to be accepted by all public agencies as a necessary response to the need for obtaining optimum use of public land. In view of the economic desirability of flood control, single-purpose management for any other purpose is considered unfeasible. However, Knightville Dam has natural resource and recreational values which would be wasted if the project were managed solely for flood control.

As the human population of western Massachusetts grows, the demand for land and its various uses will increase. It is important to the residents of this area that the land be used wisely. All land not used for picnic areas, recreation facilities and trails has been set aside for conservation and limited public use.

### C. Operation and Maintenance Alternatives - Recreation

Section 4 of the 1944 Flood Control Act (Public Law 534, 78th Congress) authorized the construction, maintenance and operation of public park and recreational facilities at flood control reservoirs. Since that time part of the Corps' responsibility has been to make provisions for various recreational uses compatible with primary flood control objectives. The large numbers of visitors to the project (over 50,000 annually) indicates that the recreational opportunities offered are popular and needed. Therefore, the discontinuance of operation and maintenance of the recreational facilities would deprive users of recreational opportunities and probably create greater pressure and, perhaps, environmental stress on other public lands.

## VI. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

### A. Inundation Impact

Periodic inundation of the reservoir during flood conditions results in short-term damage to plant and animal life. This effect will continue throughout the life of the project. However, should the project cease to operate, the reservoir would naturally revegetate and wildlife would immigrate from the surrounding region, with no significant effect on long-term productivity.

### B. Area Land Use

The land use at Knightville Dam is already committed as a dam and flood water storage reservoir. The operation of the dam has had minimal effect on land use in the area surrounding the reservoir because of the existing rural woodland character, with little pressure for development. The reservoir did eliminate some farming activity, and undoubtedly the scenic character of the river valley would attract some residential development, but development could reoccur should the project cease to operate, and the potential for long term productivity has not been destroyed.

### C. Downstream Flood Plain Ecosystem

Downstream of Knightville Dam, the flood protection provided communities on the Westfield River has probably contributed to continued development in the flood plain. This development has not been countered by effective and comprehensive nonstructural programs

by the local communities such as flood hazard area zoning to discourage building. Natural valley storage areas in the lower Westfield River basin become undesirable for the storage and slow release of flood waters, and instead require flood protection when indiscriminate development is not controlled. The flood plain ecosystem, composed of bottom land species of trees and plants tolerant of and dependent on periodic flooding, is adversely affected directly by removal of vegetation for construction of roads, parking lots and buildings, and indirectly when structural protection measures such as dams and levees reduce natural inundation of the river lowlands. These combined effects may interrupt the water balance sufficiently to alter marshes and decrease groundwater recharge. The result may be a significant decrease in long term natural diversity and productivity in these downstream areas.

#### D. Socio-Economic Effects

The downstream areas which benefit from flood control operations at Knightville Dam are highly developed and industrialized. Most of the residential, commercial and industrial developments are located on the lowlands in the city of Westfield, about sixteen miles below the dam. The flood of record for the Westfield River watershed occurred in August 1955, during which Knightville Dam was in operation and prevented damages of \$6.48 million. Residual losses in this flood were still nearly \$14 million, and serious flooding potential led to the construction of Littleville Lake in 1965.

The necessity for the flood control project lies in the hydrologic and topographic characteristics of the watershed, which has a relatively high flood potential throughout the year because of steep stream gradients conducive to rapid runoff. However, the channel slope in the Westfield area is much smaller than on tributary streams in the upper basin, causing river stages to rise more rapidly and flood waters to spread over the low-lying areas, some of which are highly developed. The magnitude of the manufacturing carried on in Westfield and West Springfield is dependent in part on the flood protection afforded by the upstream reservoirs and local protection projects in the lower watershed. Agriculture, primarily tobacco production, is also benefitted by the mitigation of flood flows. The continuation of the Westfield area as a center for industry and manufacturing is substantially beneficial to long-term economic productivity of the region.

### VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES INVOLVED IN THE OPERATION AND MAINTENANCE PROGRAM

Flood control operations involve the flooding of more than 470 acres of reservoir land on an annual or more frequent basis. The



result is that natural successional changes in vegetation are retarded and existing growth will frequently be subject to damage for as long as the dam continues in operation. Tree and other plant damage and mortality due to flooding are irretrievable losses, but in areas of only occasional flooding, vegetation is basically a renewable resource. Damage to vegetation necessarily has adverse effects on wildlife as well, which may be a reduction of the carrying capacity for game and nongame species and sometimes direct losses by flooding of nests or smaller, less mobile organisms which cannot easily move out of the flood pool area. The forest management program being planned for Knightville is one method by which irreversible losses of biological resources can be mitigated.

#### VIII. COORDINATION WITH OTHER AGENCIES

Coordination with various Federal, State and local interests resulted in valuable input to this assessment. Following is a list of several interests with whom coordination took place:

U. S. Fish and Wildlife Service

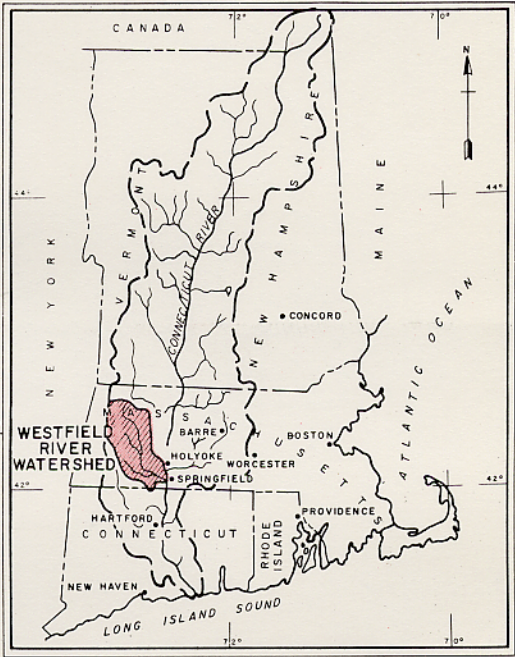
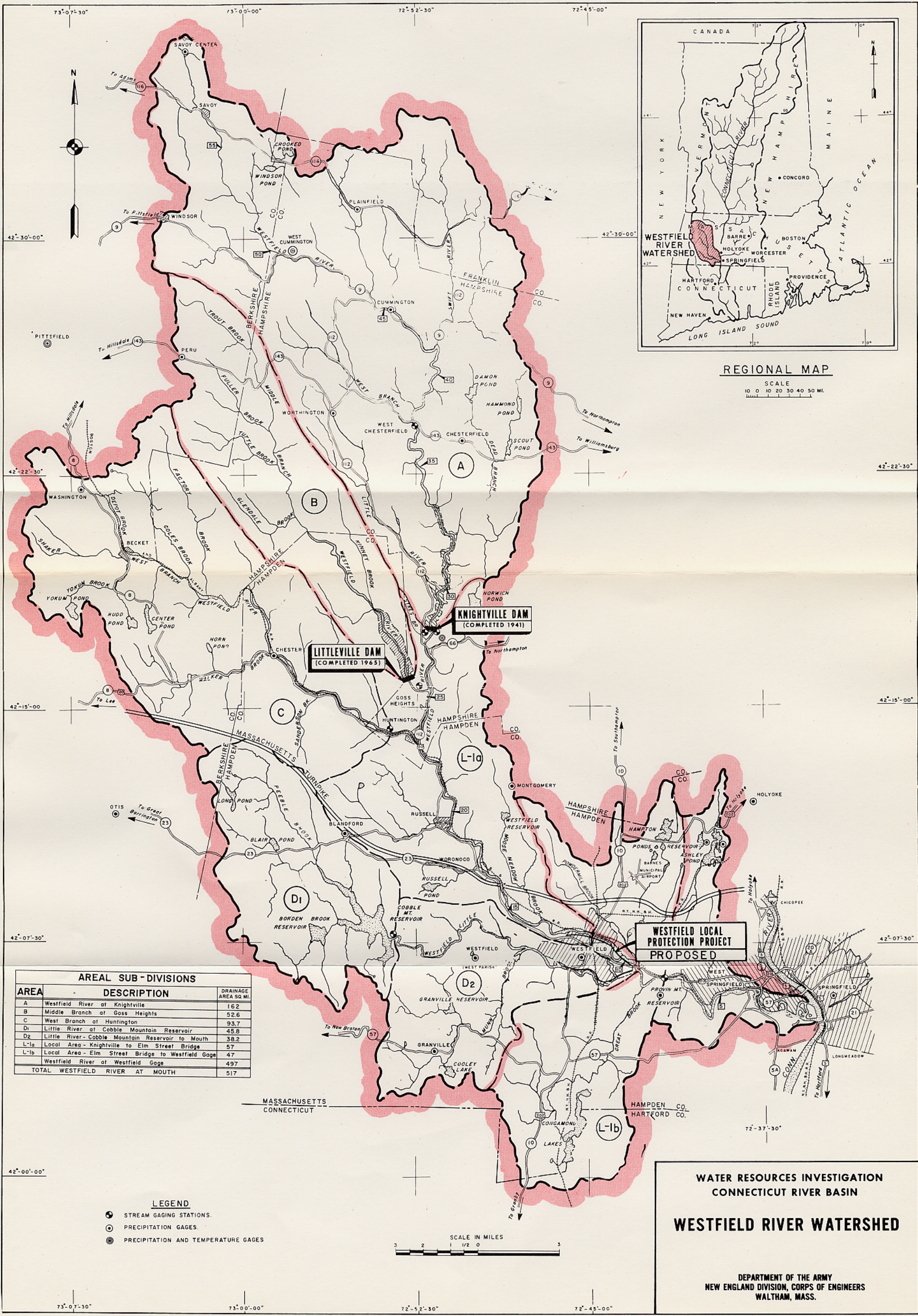
Soil Conservation Service

Massachusetts Department of Fisheries, Wildlife and  
Recreational Vehicles

Massachusetts Department of Environmental Management

Massachusetts Department of Environmental Quality  
Engineering



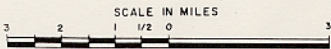


REGIONAL MAP

SCALE  
0 10 20 30 40 50 MI.

AREAL SUB-DIVISIONS		
AREA	DESCRIPTION	DRAINAGE AREA SQ. MI.
A	Westfield River at Knightville	162
B	Middle Branch at Goss Heights	52.6
C	West Branch at Huntington	93.7
D1	Little River at Cobble Mountain Reservoir	45.8
D2	Little River-Cobble Mountain Reservoir to Mouth	38.2
L-1a	Local Area-Knightville to Elm Street Bridge	67
L-1b	Local Area-Elm Street Bridge to Westfield Gage	47
TOTAL WESTFIELD RIVER AT MOUTH		517

- LEGEND
- STREAM GAGING STATIONS.
  - PRECIPITATION GAGES.
  - ⊙ PRECIPITATION AND TEMPERATURE GAGES



WATER RESOURCES INVESTIGATION  
CONNECTICUT RIVER BASIN

**WESTFIELD RIVER WATERSHED**

DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASS.



